REMARKS/ARGUMENTS

In the Office Action of November 12, 2004, the Examiner rejected claims 1 – 4 and 15 under 35 U.S.C 102(a) as being anticipated by US Patent 6,542,671 B1 (Ma et al.). Furthermore, claims 1 – 4, 12 and 15 were rejected under 35 U.S.C 103(a) as being obvious and unpatentable over US Patent 5,539,577 A (Si et al.).

Claims 5 and 18 were rejected under 35 U.S.C 103(a) as being obvious and unpatentable over US Patent 5,539,577 A (Si et al.) in view of US Patent application US 2002/0118917 A1. Claims 6, 8 – 10, 13, 19 and 20 were rejected under 35 U.S.C 103(a) as being obvious and unpatentable over US Patent 5,539,577 A (Si et al.) in view of US Patent application US 2002/0118917 A1 (Kawai). Claims 7 and 11 were rejected under 35 U.S.C 103(a) as being obvious and unpatentable over US Patent 5,539,577 A (Si et al.) in view of US Patent application US 2002/0118917 A1 (Kawai) and US Patent 5,748,816 (Jasik et al.). Claims 16 and 17 were rejected under 35 U.S.C 103(a) as being obvious and unpatentable over US Patent 5,539,577 A (Si et al.) in view of US Patent application US 2004/0208538 A1 (Liwak).

In view of the above objections of the Examiner with regard to the present application, the applicant submits the above-mentioned claim amendments. Support of the current amendments may be found on page 15, paragraph [0037], which states that "...the TIR surface for optically turning a light beam, a surface of the optical fiber facing lens through which an output light beam exits the module, a surface of the laser facing lens through which an input light beam enters the module and at least one internal area of the module may also be roughened, on their own or in combination with one or both of the first and second surfaces defining the gap to attenuate a light beam...". Paragraph [0037] further states that the surface of the optical fiber facing lens and the surface of the laser facing lens therefore define a third and fourth surfaces respectively of the module that may be roughened.

Amendments to the Drawings:

The attached sheet of drawings includes changes to Fig. 9 and Fig. 10. This sheet replaces the original sheet including Fig. 9 and Fig. 10.

In Figure 9, previously numbered element 130 has been renumbered to be 131.

In Figure 10, previously missing annotation 72 has now been included.

Attachment: Replacement Sheet

The applicant would like to note that in the office communication of November 12, 2004, the Examiner has explicitly acknowledged that the prior art does not disclose a monolithic optical coupling module comprising a total internal reflection optical turn surface portion, a third surface portion through which the attenuated light beam exits the module, and a fourth surface portion through which the light beam enters the module wherein the at least one of the total internal reflection optical turn surface portion, the third surface portion and the fourth surface portion comprises a second integrally-formed light beam attenuator.

Accordingly, independent Claim 1 and 12, which have been amended in line with this analysis, are now novel and non-obvious over the prior art. The applicant also submits that dependent Claims 2 – 7, 9 – 11, 13, 21 and 22 and corresponding method claims, Claims 15 – 20 are now also allowable.

Conclusion

In the light of the above-mentioned remarks, the applicant respectfully requests for a timely issuance of the Notice of Allowance in this application.

Respectfully submitted,

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embodiments having only some of the optical elements of the embodiment shown in Figure 8 are possible. Some of these embodiments will be described below.

[0028] With reference to Figures 9 and 10, optical coupling modules 130, 140 according to alternative embodiments of the invention are described. Each of these embodiments includes optical elements, such as a collimating lens 68, a TIR interface 72, an air gap 42 and an optical fiber facing lens 80 for generating a single output light beam 122. In the module 130 depicted in Figure 9, a VCSEL source 102 emits a diverging beam 108, which is collimated by collimating lens 68 integral to the module 130 to form a collimated light beam 110. The collimated light beam 110 in turn is reflected at a 90-degree angle ~~130~~ 131 by total internal reflection at the interface 72, to form a horizontal total internally reflected light beam 112. This light beam 112 propagates through the gap 42 to be refracted by parallel surfaces 44, 46, one or both of which are roughened as described above, to form refracted and attenuated light beam 120 that is parallel to the horizontal light beam 112. The surfaces 44, 46 are oriented with respect to the reflective interface 72 to ensure that the refracted and attenuated light beam 120 is at an appropriate height to be focused accurately onto an optical fiber 10 by the integral fiber facing lens 80.

[0029] Similarly, the module 140 depicted in Figure 10, a VCSEL 102 emits a diverging beam 108, which is collimated by a collimating lens 68 integral to the module 140 to form a collimated beam 110. This beam 110 in turn is reflected at a non-90 degree angle 132 by total internal reflection at the interface 72, to form a diagonal total internally reflected beam 112. This light beam 112 propagates through the gap 42 defined by non-parallel first and second surfaces 44, 46, (one or both of which are roughened as described above) to be refracted upward at first surface 44 to form a first refracted beam 116. This beam 116 is refracted again at the second surface 46 to form a refracted and attenuated light beam 120 which is aligned and parallel to an axis of an optical fiber 10. The integral fiber-facing lens 80 focuses the attenuated light beam 120 onto the optical fiber 10. The module 140 is manufactured such that the optical elements are oriented such that the light beam 120 is accurately focused onto the optical fiber.

[0037] Although the invention is described as implemented in the above-described embodiments wherein one or both surfaces defining a gap in the optical coupling module are roughened to a degree of roughness to function as an attenuator, it is not to be construed to be limited as such. For example, the TIR surface for optically turning a light beam, a surface of the optical fiber facing lens through which an output light beam exits the module, a surface of the laser facing lens through which an input light beam enters the module and at least one internal area of the module may also be roughened, on their own or in combination with one or both of the first and second surfaces defining the gap to attenuate a light beam. The surface of the optical fiber facing lens and the surface of the laser facing lens therefore define a third and fourth surfaces respectively of the module that may be roughened.

[0038] As another example, the attenuator may also include at least one portion of an optical coupling module that is integrally formed to have a partial beam blocking, a partial beam reflecting or a wavefront shape changing property. Figure 13 shows an optical coupling module having a surface that is formed to include a frustum that functions as a partial beam reflector. The frustum is located in a path of a light beam. When a light beam impinges on this frustum, a portion of the light beam falling on a surface of the frustum substantially perpendicular to the beam path is allowed to propagate therethrough. However, portions of the light beam falling on the slanted surface or reflective portion, oblique to the beam path, will be reflected away therefrom and not be allowed to propagate therethrough. In this manner, the light beam is attenuated.

[0039] Figure 14 shows an optical coupling module having a surface that is formed to function as a partial beam blocker. It is advantageous for a partial beam blocking type of attenuator to have a light blocking pattern, such as a radial pattern shown in Figure 7C, that is rotationally symmetrical. Such a blocking pattern provides an attenuation level that is independent of the laser mode profile, which is typically rotationally or mirror symmetric.